United States Department of Transportation
Federal Railroad Administration

Grandfathering of Non-Compliant Equipment for Use on Specified Rail Lines

FRA Docket No. 1999-6404

Initial Decision

Introduction and Summary

By letter dated October 18, 1999, the National Railroad Passenger Corporation (Amtrak) petitioned the Federal Railroad Administration (FRA) pursuant to 49 CFR §238.203(d), to permit use of five Talgo[1] articulated trainsets on three rail corridors: The Pacific Northwest Corridor between Eugene, Oregon, and Blaine, Washington via Portland and Seattle; the Southern California corridor between San Luis Obispo and San Diego via Los Angeles; and the corridor between Los Angeles and Las Vegas, Nevada. FRA approval is required because the trainsets do not meet the required compressive strength of 800,000 pounds applied on the line of draft without permanent deformation of the body structure (49 CFR §238.203(a)). The petition is required to be submitted to the Associate Administrator for Safety and is processed as a request for "special approval."[2]

The new Passenger Equipment Safety Standards (49 CFR Part 238) authorize continued use of equipment not meeting the compressive strength requirement (i.e., "grandfathering") only for equipment that was placed in revenue service on "a rail line or lines" before November 8, 1999, and for which a grandfathering petition is filed by that date. If the equipment was placed in service on any line before November 8, 1999, and a petitioner seeks to permit its use on a different line, a grandfathering petition covering that service is also required.

Any petition is required to be accompanied by certain administrative details, information sufficient to describe the actual construction of the equipment, certain engineering analysis, a

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[1]Talgo is both a brand name and the common name of a family of international and domestic corporations associated with the Spanish firm Patentes Talgo. Talgo trains of various designs have been operated extensively on European railways, and Talgo has previously constructed equipment meeting North American standards.

[2] FRA regulations at 49 CFR Part 211 contemplate that this type of proceeding will be considered by the Railroad Safety Board, an internal FRA body that is created by FRA order. The undersigned is the current chair for the Board, acting by delegation on the Associate Administrator's behalf. *See* 49 CFR §211.55.

description of risk mitigation measures planned to decrease the likelihood of accidents involving the use of the equipment, and a quantitative risk assessment for each corridor. 49 CFR §238.203(d)(3). The regulation requires that the risk assessment demonstrate that use of the equipment on each corridor is "in the public interest and consistent with railroad safety."

FRA has received an unusually large number of filings in this docket, and several were quite extensive. A public hearing was held on July 21, 2000, at which testimony was received from nine persons representing Amtrak, Washington State Department of Transportation (WDOT), Talgo, the National Association of Railroad Passengers, the American Public Transportation Association, and Bombardier. FRA has considered the public comments in reaching this decision and expresses appreciation for the careful attention to detail reflected in the submissions, as well as the expressions of support for the Cascade service.

This decision authorizes continuation of Amtrak's Cascade service on the Pacific Northwest Corridor and addresses issues common to the three corridors in a manner intended to advance ultimate resolution of the petition as a whole. FRA determines that sufficient support has been provided for concluding that continued use of Talgo trainsets in revenue service on the Pacific Northwest Corridor is in the public interest and consistent with railroad safety, subject to certain conditions. FRA notes that additional information will be necessary to resolve the appropriateness of operating the Talgo equipment at speeds in excess of 79 miles per hour in the future (an issue not directly addressed in Amtrak's petition). In addition, further information is required to decide the request for grandfathering as applied to the other two corridors.

The Talgo Consist

The five trainsets that are the subject of this proceeding are Talgo Pendular trainsets assembled in the United States in 1998 and introduced in revenue service beginning in 1999.[3] The new trainsets were specially configured for U.S. service and replaced two leased trainsets of similar design that had been in service without incident since 1994.[4] The trainset is normally a grouping of twelve cars consisting of a pair of end service cars at either end (one providing power and the other carrying baggage) first class and standard passenger coach cars, bistro (snack bar) cars, and dining cars. The number of cars used can vary to reflect fluctuations in demand. The five trainsets and five spare cars total 65 units in all for which grandfathering approval is sought.

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[3]Two trainsets are owned by WDOT. Amtrak owns one trainset and has a lease-purchase agreement on a second. The fifth trainset is owned by Talgo but has been made available to Amtrak for limited service on the Pacific Northwest Corridor (as well as for test and demonstration purposes), and is expected to be leased by Amtrak for the Los Angeles-Las Vegas service.

[4]The principal known difference between the original leased trainsets and the new trainsets was the addition of collision posts in the end-service and baggage cars at the ends of the train. In addition, compliant FRA glazing is employed in the new trains. The older leased trains were hauled by a conventional locomotive, but a de-powered locomotive was used on the other end toward the end of their use in revenue service.

For purposes of revenue service in the Pacific Northwest, Amtrak has hauled the trainsets using an F59PHI locomotive of the same kind used on many other Amtrak trains. In addition, in order to facilitate push-pull service Amtrak has placed a de-powered F40 locomotive/cab control unit at the end opposite the locomotive. The F40 serves as the controlling locomotive when the consist is in push mode. When the consist is being pulled by the F59, the F40 provides some additional protection to the trainset in the case of a rear-end collision.

The five trainsets covered by Amtrak's petition were built to meet the requirements of International Union of Railways Standard UIC-566-OR and the Specifications of WDOT Contract UC-3260 dated July 31, 1996. As stated in the Petition for Grandfathering, Amtrak and Talgo agreed that any additional trainset orders will comply fully with 49 CFR Part 238.[5] All five of the existing Talgo trainsets are also compliant with the Americans with Disabilities Act.

Amtrak has provided information affirming that each of the five trainsets was used in revenue service prior to November 8, 1999.

The Corridors

Each of the three corridors described in the petition is comprised of trackage owned, dispatched or operated under trackage rights by The Burlington Northern Santa Fe Railway (BNSF) and the Union Pacific Railroad (UP). Each of the corridors involved carries significant freight and passenger traffic.[6]

The Pacific Northwest Corridor from Eugene to Portland, Oregon, is owned by the UP, and from Portland to Seattle by the BNSF. On the Pacific Northwest corridor, Sound Transit is beginning what will become a very active commuter rail service on BNSF between Tacoma and Seattle this fall (growing to 18 trains each day), with a later service extension to Everett. Amtrak operates intercity trains, including the Cascade Service (which utilizes the Talgo trainsets).

Between San Diego and Los Angeles, California, commuter service is provided by the North (San Diego) County Transit District (Coaster Service) and by the Southern California Regional Rail Authority (Metrolink). The track is owned by these public authorities, and BNSF provides freight service. Amtrak provides intercity passenger service at speeds up to 90 mph (San Diegans, Surfliners).

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[5]This decision may not be construed to comment in any way on the issue of next-generation Talgo equipment, which is not the subject of this proceeding.

[6]The Petition in this docket (1999-6404-1) appends risk assessments that detail traffic levels by route segment.

On the route north of Los Angeles, between Los Angeles Union Station and Moor Park, Metrolink owns the line. UP owns the balance of the line to San Luis Obispo and provides freight service. Metrolink provides passenger service as far north as Oxnard. Amtrak operates intercity passenger trains to San Luis Obispo now marketed as the Pacific Surfliner service.

Between Los Angeles and Las Vegas, line ownership is divided among Metrolink, BNSF and UP. BNSF and UP provide freight service over line segments they own or where they enjoy trackage rights. Metrolink operates commuter trains to San Bernardino. Amtrak operates intercity trains from Los Angeles to Barstow (and previously had provided service to Las Vegas).

Nature of the Proceeding

This is a special approval proceeding under which FRA must determine whether certain rail equipment may be operated under the terms of the new Passenger Equipment Safety Standards (64 FR 25540; May 12, 1999). The issue here is not whether the regulation should be "waived," but rather whether, in the context of the particular rail operations, the absence of otherwise required compressive strength causes the equipment to fall significantly short of the performance that would be expected of equipment having the otherwise required strength, so that its continued use is not consistent with railroad safety. Section 238.203, which establishes the "buff strength" requirement and provides for grandfathering in appropriate cases, places the burden of proof on the applicant to show that the proposed usage is "in the public interest" and "consistent with railroad safety". 49 CFR § 238.203(h)(2) [7]

The central purpose of the buff strength requirement is to ensure adequate compatibility among the units of rail rolling stock already deployed on the general rail system (64 FR 25545) with respect to collision risk (including, as relevant, secondary collisions within trains). The required buff strength also benefits crews and passengers in derailments where secondary collisions occur and in highway-rail crossing collisions.[8]

The buff strength requirement is the only structural requirement of the new passenger equipment standards made applicable to existing equipment. Other structural requirements are being phased in as new equipment is ordered and delivered.

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[7]Amtrak's petition itself references appropriate public interest factors, and those factors were supported by Mr. Uznanski of WDOT at the public hearing on the petition.

[8]Although rail equipment is typically of a much higher mass than motor vehicles competing for occupancy of highway-rail crossings, the significant speeds associated with intercity and commuter operations, the mass of rail passenger cars, the mass of heavy highway vehicles (including those operating with heavy loads under special permits) and the potential for secondary collisions within the consist or with fixed objects or standing rail equipment all contribute to the importance of highway-rail collisions as a factor in any risk assessment. This is particularly true at crossings where automated warning devices are not provided and heavy highway vehicles may be present.

In addition to recognizing the use of crush zones in equipment designed to provide crash energy management, the rule outright excepts four types of equipment from the buff strength requirement. The first exception applies to several of the structural requirements and is applicable to systems such as Port Authority Trans Hudson, which operate only lighter equipment under circumstances where high-energy collisions are less likely and the disparity in mass among the various types of rolling stock in the system is much less than would typically be encountered in the general freight railroad environment (§238.201). The second, referenced in §238.203(a)(3), is a locomotive that has a very strong underframe to protect the crew, but cannot meet the 800,000 pounds at the rear draft stops. Both of these exceptions are intended to recognize practical reality under circumstances where it was clear that safety would not be compromised. The third exception is for private cars, for which the design lineage could be difficult to reconstruct and for which the risk exposure is generally lower given the reduced miles operated (§238.203(a)(4)(i)). The fourth exception is for unoccupied "passenger equipment" such as express cars hauled at the back of a train (§238.203(a)(4)(ii)).

This proceeding has the objective of determining whether a particularized exception could be provided under specific design and operating circumstances presenting much more complicated issues than those resolved in the categorical rule exceptions. In adopting this mechanism in the final rule, the agency stated as follows:

> FRA plans to "grandfather" equipment only for use in particular operating environments providing a sufficient showing is made that any incremental safety risk incurred in those environments is not of significant concern or that specific measures mitigating the risk to the traveling public and to railroad employees are utilized. Petitioners will need to demonstrate–through a quantitative risk assessment that incorporates design information, engineering analysis of the equipment's static end strength and of the likely performance of the equipment in derailment and collision scenarios, and risk mitigation measures to avoid the possibility of collisions or to limit the speed at which a collision might occur, or both, that will be employed in connection with the usage of the equipment on a specified rail line or lines–that use of the equipment, as utilized in the service environment for which recognition is sought, is in the public interest and is consistent with railroad safety. In this regard, FRA notes that passenger equipment not possessing the minimum static end strength specified in this rule does not have the same capacity to absorb safely within its body structure the compressive forces that develop in a collision as equipment meeting the standard. The engineering analysis submitted by the petitioner should address how these forces will be dissipated in a manner that does not jeopardize occupant safety in collision scenarios.

64 FR 25603-25604.

It is important to note the limitations of this proceeding. Some commenters have asked FRA to state categorically that decisions made here do *not* constitute precedents with regard to determinations of compliance with the regulations for new equipment. At least one commenter has insisted that, if FRA provides relief in this docket, the agency should provide a definitive prescription of what risk assessment requirements will be for other proceedings, including evaluation of shared use applications for light rail service. *See* 65 FR 42526; July 10, 2000. Other commenters have asked FRA to take into consideration issues that go far beyond the general subject of compressive strength.

The scope of this proceeding is quite limited. The only issue is whether Amtrak's use of the five Talgo trainsets on one or more of the three corridors identified in the petition is in the public interest and consistent with railroad safety in light of the buff strength of the vehicles. This is not a rulemaking for development and prescription of risk assessment techniques. Nor is this a rulemaking or special approval proceeding designed to determine compliance of Talgo-built equipment with other provisions of the standards.[9]

This last point requires some elaboration. An industrious commenter to this docket has used the Freedom of Information Act to obtain notes of meetings among FRA, Amtrak, and Talgo representatives and other internal documents, copies of which have been placed in the docket for reference. The materials describe a large number of safety topics that have been the subject of discussion between FRA and those parties, particularly during the period October 1998 to October 1999.

The implication of some comments has been that, if FRA raised an issue in those talks at any time, then FRA may not grant relief in this proceeding unless the issue was resolved to the satisfaction of the commenter. FRA is in no way so constrained. The context of FRA's discussions with Amtrak and Talgo over the months since issuance of the final rule has involved a continuing dialogue over a wide range of safety issues. Quite naturally, the necessity to gain technical information necessary to resolve this proceeding has been a critical element in those talks. FRA staff did work with Amtrak to ensure adequate information would be available to decide this matter and that Amtrak and Talgo had made every effort to explore risk mitigation with respect to the trainset itself. However, FRA's relationship with Amtrak or any other railroad is not limited to any single safety issue at any given time. This is particularly true for Amtrak, since the Secretary of Transportation sits on the railroad's board of directors, and FRA is the funding agency for intercity rail passenger service. FRA encourages Amtrak to exceed minimum safety standards, and Amtrak does so with some regularity.[10] Much of the discussion cited by commenters arose in this context.

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[9]One commenter asked that we declare a policy to become involved in equipment acquisitions at an early stage. FRA welcomes the opportunity to consult at the specification development stage of procurement and regularly does so when given the opportunity. This is not the place, however, to declare policies of general applicability.

[10]For instance, Amtrak has pursued a well-structured program of daily mechanical inspections for its trains for several years as a result of partnership efforts, anticipating the requirements of the Passenger Equipment Safety Standards that are only now beginning to go into effect.

This proceeding is not about safety equivalency for the Talgo trainsets. Were that the case, it would be difficult to determine that to which the trainset should be equivalent, since the North American passenger car fleet is by no means uniform in its characteristics. Although with the noted exceptions all North American equipment is believed (and by regulation is rebuttably presumed) to meet the 800,000-pound requirement, it varies widely with respect to other features. For instance, collision posts for older passenger cars may not be of full height, while others are. Some older cars have corner posts that meet the requirement for new equipment, while many others do not. In other words, the new regulations tolerate considerable variation in safety levels within the existing fleet so long as basic compatibility is achieved. This kind of approach is necessary to progress in any field of safety where major capital expenditures are required and avoidance of waste is essential to fashioning cost-effective requirements.

This does not mean, however, that FRA is limited to a "tunnel vision" review of this petition. Buff strength is a useful indicator of safety only to the extent it occurs within a system for transferring loads. Service, derailment and collision loads are seldom transferred in an exclusively longitudinal fashion, with no lateral or vertical components. North American equipment has been designed to transfer loads of varying types in a reasonably efficient manner. In particular, requirements for the coupler and draft system derived from longstanding Association of American Railroads private standards,[11] some of which are incorporated into the standards for new equipment, include a requirement to resist at least 100,000 pounds of vertical force (§238.205). In North American practice, retention of the truck to the carbody has also provided an important secondary check against longitudinal incursion of one car into another (permitting the adjacent vehicle to more safely carry the compressive load), as well as helping to avoid damage to adjacent vehicles as a result of detachment.

The rule does not ask that the five trainsets conform to the specific requirements of the new rule applicable only to new passenger equipment. However, in reviewing the safe operation of equipment that does not meet the 800,000 pound requirement, that uses articulated connectors in lieu of North American draft arrangements, and that carries compressive loads through a larger section of the carbody, it is very appropriate–indeed, necessary–for FRA to examine the larger system in which this load transfer occurs. From the point of view of the trainset's performance in the relatively harsh North American environment, the issue is its ability to protect occupants in a wide range of scenarios, avoiding collapse or telescoping of car units that could reduce survivable volume and excessive jacknifing of equipment that could render the equipment vulnerable to movements on adjacent tracks. Recognizing that some uncertainty exists regarding actual accident outcomes in the case of equipment that is relatively new to the service environment (and for which, happily, we have little documented accident experience), FRA staff have also aggressively explored options for any other enhancements in safety that might offset any

[11] Now superseded by the American Public Transportation Association's ***Manual of Standards and Recommended Practices for Rail Passenger Equipment*** (July 1, 1999).

remaining uncertainty (discussed below) as other matters were resolved.

Findings Specific to Trainset Characteristics

FRA has reviewed the petition and all available information regarding the construction of the five Talgo trainsets, including–

- Results of finite element analysis (FEA) provided to Amtrak by Talgo.
- The one-dimensional lump mass analysis conducted by LTK Engineering for Amtrak.
- Photographs of accident scenes in Europe involving equipment said to be of similar construction.
- Information concerning a test of the compressive properties of the baggage car in a test for Amtrak conducted in Spain.[12]
- Representations and analysis concerning the safety implications of these data by Amtrak and Talgo engineering staff.

FRA engineering staff members have also inspected the equipment in a train yard environment, and FRA inspectors responsible for routine field monitoring of the operation have been queried regarding any issues that may have arisen since the equipment's introduction (including the service experience of the previous two trainsets of somewhat similar design, which were introduced in revenue service in 1994).

The information provided appears to be sufficient to support the following findings:

1. The Talgo trainsets conform to Union of International Railway (UIC) standards with respect to compressive strength, which require an ability to withstand 200 metric tons (441,000 pounds) of static end load. (It is impossible to say, without some analyses or tests of a Talgo car and a typical North American car with genuinely equivalent loading conditions, that the occupied portion of the Talgo approaches the effective compressive strength of typical North American equipment. There are differences in how the loads are applied for the 800,000 buff test for North American equipment and the Talgo analysis.)

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[12]The Spanish squeeze test data was submitted in tables in charts contained in Volume II of the three-volume set, in the section titled "Protocol and Reports of the Baggage Car Structural Resistance Testing." The data cannot be fully evaluated because the section does not contain precise information on the placement of the strain gages. Nor does the three-volume set contain sufficient information on the properties of the material used to construct the car. Specifically, the strain to yield and the strain to fracture values for the material used to construct the car are not supplied.

2. Unoccupied units at each end of the trainset are likely to be helpful in absorbing crash forces in the event of a collision. It is true that these units were not designed as "crush zones" with elements carefully formed to deform gracefully and predictably. However, neither is that the case with typical North American equipment. For moderate energy collisions (e.g., 30 mph closing speed with a similar consist), the following consist configurations and scenarios would apparently be at least as vulnerable as, or perhaps more vulnerable than, the Talgo consist at issue here:

   - An Amtrak locomotive with an occupied passenger car coupled to it (in a head-on collision).

   - An Amtrak push-pull consist with a passenger- and crew- occupied cab car in the lead (in a head-on collision).

   - An Amtrak locomotive-led consist with an occupied passenger car as the rear car in the consist (in a rear-end collision).

   Each of the above is permissible under all applicable regulations (though none is typical for the average Amtrak intercity consist).

3. The full consist configuration, with a conventional passenger locomotive providing motive power and a de-powered locomotive/cab control unit on the other end, offers some protection in possible collisions involving freight movements and at highway-rail crossings. For instance, this arrangement offers advantages when compared with a consist of multiple-unit cars (diesel or electric power) with passengers present in both the lead unit and the trailing unit in both directions of travel (a configuration permitted under existing regulations).[13]

4. The trainset's articulated design and lower compressive strength should have additional benefits in low-to-moderate energy collisions and derailments.

   - The articulated design of the trainsets may tend to assist in retaining the occupied units in line, at least in low energy events.

   - At least some of the collision energy is likely to be absorbed by failure of the articulated connectors and crushing of the suspension/draft system between the units, due to the apparent relative fragility of the articulation in comparison with the carbody.

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[13]Most consists of this type are operated with cab signals and automatic train control, as well as with most or all highway-rail crossings signalized. These consists are used principally in commuter service.

5. Practical and limited modifications to the trainsets can strengthen the crash performance of the vehicles. During discussions with Amtrak and Talgo prior to submission of the petition, FRA staff engineers focused on several areas of apparent weakness in crash scenarios that were capable of being readily addressed through design modifications.[14] These limitations had to do with support of the carbody at the end where it is suspended by weight bearing bars and resistance to override, the retention of the bogie (truck) and suspension towers in an upright position associated with the units they support, and keeping the articulated units together after breakage of the articulated connection. Addressing these needs will help ensure that the trainset remains upright and in line, that loads are efficiently transferred down the length of the train, and that the bogie does not become a missile capable of entering the occupied volume. The following modifications were agreed to:

   a. The rail cars will be modified to increase the strength of the weight bearing bars (two per car) and their related supports to the car structure, to withstand a minimum of 100,000 pounds vertical load, applied either up or down.

   b. The rail cars will be modified by applying safety cables between the cars and bogies to resist a minimum total longitudinal force of 77,162-pounds (35,000 Kg) (determined by Talgo to be the limit of the structural design of the ends of the cars) to mitigate separation of the carbodies and bogies (and thus separation of cars from one another).

   c. The rail cars will be modified by applying a safety cable around the top of each suspension column, affixed to the upper structure of the cars to resist the application of a nominal 250,000 pound load applied at the center of gravity of the bogie.

   Despite their view that these changes were not necessary, Amtrak and Talgo agreed to make these changes if FRA approves the petition. Talgo has estimated the installation period at nine (9) months, but Amtrak requested at least one year to accomplish this work.

These findings tend to support approval of the petition. On the other hand, significant questions remain concerning the performance of the trainset in moderate to high energy collisions. These questions include the extent to which buff forces are successfully transferred up to the point when the articulated connection fails, the manner in which the connection fails and its impact on surrounding structure, the degree to which compression of the bogie and suspension system helps

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[14]The rule does not require, and FRA does not find, that these improvements will cause the trainsets to be "equivalent" to equipment having the otherwise required buff strength or built to other public or private standards for truck attachment, tensile (draft) loads, collision posts, etc. FRA finds only that the improvements should contribute to enhanced safety.

arrest--or contributes to--lateral or vertical displacement of the passenger cars, and the "force crush characteristics" of the carbody shell. Some of these issues are relatively straightforward, while others are very complex. Although the complexity of the issues would almost inevitably leave some questions (as is the case with respect to conventional equipment), FRA would have expected that more would have been known at this stage of discussion than is, in fact, the case. The following findings tend to illuminate this problem:

6. FRA's knowledge concerning the construction of the trainsets is not as extensive as would be necessary to complete analysis with a high degree of confidence. Notwithstanding the requirement of §238.203(d)(3)(ii) that the petition include "information, including detailed drawings and material specifications, sufficient to describe the actual construction of the equipment," Amtrak has not submitted detailed engineering drawings for much of the critical detail in the trainset design.[15] Additional information is also needed with respect to materials. FRA has been provided the yield stress and ultimate stress for the parent material, but still needs the stress/strain curves for the parent, weld, and heat-affected zone (HAZ) materials. (To perform a plastic analysis, we need to know the yield strains and the ultimate strains for the parent, weld, and HAZ materials.)

7. The finite element analysis submitted with the petition is useful, but has notable limitations not acknowledged in the Amtrak submission. Talgo has elected to inform Amtrak and FRA regarding the characteristics of the trainset principally by submitting a rather extensive body of displays reporting the results of finite element analysis using a computer modeling tool. FRA found this body of work to have the following limitations:

   - Certain elements of the design, such as the area of the structure where the articulated connection is mounted and where there are a number of structural stiffeners, do not appear to have been analyzed using a sufficiently fine "mesh" to accurately predict the results of stresses in these critical areas.

   - The modeling technique, while apparently useful to describe the force levels at which the material will yield (i.e., begin to deform plastically), is not capable of determining what happens beyond that point. Thus, the analysis does not shed light on whether the structure will deform gracefully, absorbing energy, or buckle or tear in a less graceful manner. Importantly, the analysis does not properly

[15]Various drawings have been provided that are very helpful in understanding the trainsets' basic design and functioning, but Talgo has apparently been concerned that filing of detailed, dimensional drawings (of the type that would be used by engineers in manufacturing the equipment) would result in disclosure of content with proprietary value.

[16]Talgo representatives maintained their view that the analysis was valid to describe force crush characteristics of the trainset. FRA respects this difference of opinion, but must rely upon its own judgment in rendering a decision.

describe the force levels associated with plastic deformation when design limits for normal service are exceeded.[16]

8. Amtrak's Crashworthiness Analysis, while useful and supportive of the petition, is subject to certain limitations. Amtrak, with assistance from LTK Engineering, a firm with recognized expertise in this field, prepared a Crashworthiness Analysis which was filed as Appendix C to its petition. It included attention to longitudinal crush and accelerations in train-to-train collisions, stability of the Talgo trainset under "high buff load" (lateral buckling), and override or climbing at coupled interfaces.

The collision scenarios analyzed with the one-dimensional crush model included a head-on collision of a Talgo trainset moving at 30 mph with the following trains (in each case not moving):

- Identical Talgo trainset (moving train led by an F-59 [emergency brake application] into standing F-40 Cab-Baggage [full service brake application]);

- The locomotives of a conventional passenger train (three F-59 passenger locomotives with an ultimate strength of 1.5 million pounds); and

- The locomotives of a conventional North American freight train (three F-59 freight locomotives; ultimate strength of freight locomotives is considered three times that of passenger locomotive, i.e., 4.5 million pounds vs. 1.5 million pounds).

According to Amtrak, the analysis concluded that--

- "in train-to-train collisions, crush is limited to unoccupied zones [presumably the car ends, including end door vestibules, and the baggage/service cars], and acceleration levels are well within accepted limits";

- "Talgo resistance to lateral buckling under high buff load is equal to or better than conventional North American passenger equipment consist"; and

- "Climbing forces during collisions, estimated conservatively from the results of the collision analysis, are within the capability of the structures between coupled units in the Talgo trainset to resist without ultimate failure."

It should be noted that analysis of lateral buckling (at low to moderate speeds) showing

[16]Talgo representatives maintained their view that the analysis was valid to describe force crush characteristics of the trainset. FRA respects this difference of opinion, but must rely upon its own judgment in rendering a decision.

good performance by the Talgo trains in comparison with other Amtrak equipment confirms expectations, but is really a derailment threshold analysis that to some extent begs the question (since for conventional equipment derailment and buckling of a sawtooth nature is normally considered useful to dissipate energy). The following issues were raised in FRA's review of this document:

(a) Force crush characteristics of the Talgo equipment were apparently taken, in large part, from Talgo's finite element analysis. Like FRA, Amtrak and its consultant were apparently not privy to certain design details or materials specifications for the equipment.

(b) The most challenging case examined involved three freight locomotives, assumed to be F59s with stiffened freight characteristics. F59 freight units are apparently presumed to have the same weight as the passenger unit (273,000 pounds each), while typical road freight locomotives of recent design have weights well in excess of 400,000 pounds.

(c) The Crash Analysis (p. 23) assumes that the baggage and service cars have collision posts conforming to §238.211, which requires new passenger cars to have two full-height collision posts at each end capable of withstanding 300,000 pounds of force at attachment to the underframe. If reinforcement is used to provide the shear value, the reinforcement shall have it's full value for a distance of 18 inches up from the underframe connection and then taper to a point approximately 30 inches above the underframe connection. According to the report, "it has been assumed that the posts, when engaged by the end of the locomotives during crushing, will efficiently transfer the loads to the roof and underframe of the Talgo end units without gross deflection or premature failure...[permitting] use of the same structural stiffness characteristic curve for the Talgo end units as was developed for the occupied intermediate units."

It is not clear how sensitive the analysis is to this assumption, but its foundation is open to some doubt. Technical information provided by Talgo states that the collision posts were originally designed for a 200,000 pound force, since the train weighed less than 600,000 pounds.[17] Subsequently, the collision posts were analyzed for the 300,000 pound load. The submitted data goes on to say that the analysis showed areas of plastic deformation, but that plastic deformation is allowed by AAR Volume C-II.

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[17]Prior North American Practice had distinguished the buff strength requirements for lighter and heavier trains, although lighter equipment has not been built for service on the general system for some time. *See, e.g.,* 49 CFR § 229.141 (applicable to older multiple-unit cars). The Passenger Equipment Safety Standards abandoned that distinction on the ground that equipment should be compatible from train to train, as well as within a train.

Appendix B of the petition in Res_fr3T.doc states, for Case 9A for the end service car, that the maximum stress is higher than the yield strength [stress], that the values of the stress are due to applying the load over a small area, and that the yielding is limited to the area where the load is applied.

The following observations are necessary:

1. This analysis is performed using a linear finite element model. The linear model is not valid when the material exceeds its yield stress, as it does in this load case.
2. Assuming for purposes of argument that the model is valid, the results indicate that the collision posts would fail in the area of the load application, i.e., the maximum calculated stress exceeds the ultimate stress of the material.
3. The area the load is applied over, 162 square inches, is large compared the "point load" required by the rule.
4. The FRA final rule (§238.211) says, "Each collision post shall have an ultimate longitudinal shear strength of not less than 300,000 pounds at a point even with the top of the underframe member to which it is attached." The post may indeed have such strength at the area of attachment, while not having such strength at the area of load application.

Further, Amtrak assumed effective transfer of loads through the collision posts even though "analysis of the associated structural connections is not available."

(d) The one-dimensional collision analysis addresses only accidents at 30 mph closing speed (which is understandable given the state of the art and the time available for preparation of the analysis, but does not speak directly to higher speed events).

(e) Use of sensitivity cases in which the assumed strength of the Talgo cars was increased by various amounts did not effectively substitute for "time-dependent, large-deflection analysis of the structures....[or] dynamic crash test[s]," which were not available (pg. 24).

(f) It is not certain that the lower accelerations credited to the Talgo equipment (reducing occupant casualties) are entirely correct. It would be expected that accelerations in occupied spaces might be reduced if the unoccupied end cars deform gracefully and if crush at the connections is as successful as posited (as compared with occupied conventional cars directly coupled to the locomotive). However, in the Amtrak Crashworthiness Analysis, a filter with a very low bandwidth was used to filter the accelerations predicted with the LTK model, which may have significantly reduced these accelerations. The concern is that, because of the low bandwidth, some of the data were filtered away with the noise.

This may contribute to the Talgo cars' appearing to having decelerations similar to conventional cars. Even if the Talgo cars have about half the strength of conventional equipment (making them softer as crush occurs), they also only have about one third the weight. Because the weight is reduced more than the strength, the acceleration may be greater for the Talgo than for conventional equipment under some circumstances.

(g) The analysis of vertical override load appears to be somewhat flawed, since the capacity of the articulated connection is less than the calculated load. (However, this would be remedied by the modifications to the weight-bearing bars required below.)

9. <u>The behavior, in high-impact events, of welds joining sections of the carbody longitudinally, is not fully known</u>. The Talgo carbodies are fabricated from aluminum extrusions welded together with various techniques for reinforcement of the structure. The expected problem (if any) would arise if the compressive load is applied off center. In discussions with Amtrak and Talgo, FRA engineers queried whether the longitudinal welds might fail as a result of reduced material strength in the heat-affect zone (HAZ) of the weld. Information provided by Talgo regarding accident experience in Spain tends to support the claim that this will not occur. However, this experience is limited, and engineering analysis made available by Amtrak is not sufficient to resolve this issue. Again, this issue would be of potential concern in higher-energy events, such as those at relatively higher speeds or involving a large mass striking the trainset (e.g., a consist of several heavy freight locomotives).[18]

Findings Related to Accident Data

10. <u>Details provided by Amtrak concerning European accidents are limited, making the information difficult to evaluate</u>. Major accidents in the United States are investigated by the National Transportation Safety Board, which typically issues exhaustive narrative reports and maintains dockets rich in detail on a wide range of issues. FRA also gathers extensive information that is shared with the Board during the accident investigation. Both agencies act with complete independence from the railroad company. So far as FRA can determine, equivalent information is not available regarding a set of four accidents that

[18]Talgo representatives have expressed confidence that weakness in the area of the heat affected zones is not an issue, given the overall fabrication methods. Notes of technical discussions appear to reflect a growing sense of exasperation that they were being asked to prove a negative in the absence of affirmative evidence that this is a real issue. FRA appreciates the difficulties inherent in this line of discussion. This is not a finding that the train will "unzip," nor does it reflect any demand that the trainset be invincible in events that could prove catastrophic for other equipment designs. We simply note that technical closure could not be achieved, leaving an area of uncertainty that FRA needs to take into account along with other factors.

occurred in Spain. Material provided to FRA consisted of photographs, track layouts, explanatory notes, and newspaper articles. While helpful in confirming that Talgo equipment is likely to maintain its structural integrity in a derailment setting or an event such as a highway-rail crossing collision with an automobile or small truck, the information is apparently not dispositive regarding the likely consequences of a typical collision involving conventional North American passenger or freight equipment.[19]

11. Spanish collision accidents may be dissimilar in nature from those that would be expected in North America. For instance, photographs from the accident of May 30, 1986, show significant damage to the locomotive of a freight train which struck a Talgo consist in the rear. A North American locomotive would no doubt deform somewhat in such an event, but its stiff underframe would be more likely to transfer destructive forces to the consist struck. Similarly, a North American locomotive is more likely to transmit forces to the trailing trainset in a collision with a consist having equal or greater mass or in an impact with a fixed object or heavy highway load (such as a transformer).

12. Information concerning domestic Talgo accidents is helpful to Amtrak, but of limited use. Amtrak notes several highway-rail crossing collisions involving light motor vehicles and a collision with a mud slide in support of the trainsets' performance. FRA agrees that these events reinforce the competence of the trainsets to handle most events within the service environment, but evaluates each as relatively low in potential severity.

Findings Concerning Risk Assessment Assumptions

Amtrak submitted four risk assessment documents–one each for three corridors and a fourth dealing with the impact of Positive Train Control (PTC). These documents were prepared by Arthur D. Little, Inc., a firm that has prepared similar analyses for FRA under contract to the Volpe Center. The discussion under this heading deals with the input assumptions regarding the trainsets' performance in various scenarios. These assumptions directly drive the findings of relative risk in each of the corridor studies.

13. Confidence in the results of the risk assessment cannot exceed confidence in the input assumptions. The risk assessments for the three corridors rely upon the aforementioned analyses and accident data for input assumptions. For the speed range 0-30 mph, FRA finds the assumptions to be within the range of reasonableness based on engineering judgment, given the assumptions concerning the make-up of conventional consists to which the Talgo trainsets are compared. To the extent that the assumptions are employed in an attempt to predict the trainsets' performance in higher-energy events, they infuse the

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[19]This discussion does not imply that definitive accident data are a requirement or that any publicly available materials were withheld. FRA appreciates the information supplied.

risk assessments with considerable uncertainty. Some of this uncertainty is inevitable, given the limited service history of trainsets of this design in North American service. However, better data concerning the dynamic performance of the trainsets would tend to better center and temper the analysis. The considerable uncertainty associated with the risk assessment counsels the need to identify risk mitigation strategies and to pursue additional data before making determinations with respect to service still in the planning stages.

14. The record presents additional issues that are not fully developed in the risk assessment but which warrant examination:

a. **Conventional draft arrangement.** Talgo fabricated a steel structure that is appended to the aluminum structure of the end service and baggage cars of the trainsets. This structure includes the draft gear for the type H tightlock coupler and the collision posts. Amtrak's Crashworthiness Analysis (p. 23) indicates that the railroad does not know how the structural connections were made. Failure of the draft arrangement in service could lead, *inter alia*, to a separation of the train and a secondary collision, introducing a new hazard not contained in the risk analysis.

b. **Heavy locomotive in the rear.** In contrast to operation of the leased trainsets, which were hauled by a locomotive leading the consist during most of their service period, the current operation is push-pull, with a de-powered F40 cab control vehicle on the front in the push mode, and at the rear of the consist in the pull mode.[20] Based upon available information, FRA agrees that use of the F40 is necessary in lieu of a regular cab car if a push-pull operation is to be continued. FRA is uncertain whether to require use of the F40 exclusively to protect the rear of the train. On the one hand, the presence of a large mass object on the end of the train should offer significant protection in a rear-end collision. However, as identified in the risk assessments, some additional hazard is incurred by placing a relatively large mass object at the rear of the Talgo consist. FRA understands that Amtrak has reviewed the issue of in-train forces during normal operation and has found that there is no appreciable risk of the trainset being "stringlined" by in-train draft forces or "squeezed off" by buff forces. However, the potential for damage in the case of a derailment or collision remains, since the trailing locomotive (F59

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[20]During technical discussions prior to filing of the petition in this docket, Amtrak stated that use of the F40 was elected so that push-pull service could be conducted, avoiding the necessity to turn the train during normal operations.

[21]For instance, in a collision, heavy buff forces applied from the rear of the trainset along with differences in sill heights might cause the interior end of the "end service" car to lift, permitting lateral or vertical buckling of the trainset.

or F40) will not brake at the same rate as the trainset, and the potential for eccentric behavior within this hybrid consist has not been explored.[21] In a somewhat oblique way (i.e., through a comparison of a conventional locomotive-hauled train with a conventional train having an F40 control cab on the other end), the risk assessments note this hazard--suggesting that the trade-off with protection from infrequent rear-end collisions may not be favorable--but the basis for estimating incremental risk is not documented.

Upon additional reflection, FRA believes that the risk assessments could have provided more explicit comparisons between Talgo consists, with and without the F40s. They could also have explored additional hazards related to having an unpowered locomotive at the end of the consist. For instance, adding a unit to any train marginally increases the derailment hazard related to equipment-caused events. This is a normally a very low risk. However, Amtrak has experienced ride quality difficulty with these F40 "cabbage" cars on the Pacific Northwest corridor and the Michigan corridor. While these issues have not given rise to any mishap, some risk may be entailed by using them in this manner.
Adding the heavy F40 also increases the stopping distance of the train. Although in general trains cannot stop short of obstructions that must be detected by line of sight, in some cases the train can be slowed or stopped, avoiding or reducing the severity of the event to the benefit of crew members and passengers. The Cascade train consist apparently has a very acceptable braking curve given the signal spacing and maximum allowed train speed. However, the push-pull consist will stop less quickly than a locomotive-hauled Talgo consist.

Of greater concern would be a serious collision (whether primary or secondary) between the front of the train and a heavy object (e.g., a freight locomotive consist, a cut of loaded freight cars, an overweight highway load, or a fixed structure). Concerns would include greater crush of occupied space as well as increased risk of buckling. If the F59 were at the rear, the effect could be accentuated, particularly if the engineer lacked the time to react and the engine continued to provide power to the consist during the initial ride-down.[22]

All of these risks entail low probabilities, so for the present Amtrak should retain the ability to consider them in relation to the protection that this push-pull

[21]For instance, in a collision, heavy buff forces applied from the rear of the trainset along with differences in sill heights might cause the interior end of the "end service" car to lift, permitting lateral or vertical buckling of the trainset.

[22]This is a potential concern common to all push-pull operations. However, the concern would appear to be amplified by the greater differential between the locomotive and the trainset in mass and compressive strength and the relatively less robust connections between the cars.

configuration provides in a rear-end collision and in light of the apparent cost and time savings from not having to turn the trains. However, in the conditions below, FRA requires additional information that could confirm the neutral position taken by this decision, support requiring the use of a powered or depowered locomotive in each end, or support restricting the use of any locomotive on the rear of the train.[23]

c. **Fuel tank.** An aluminum fuel tank with a capacity of 300 gallons is suspended under the floor of the end service car, supplying the auxiliary generator which provides head-end or "hotel" power for the train. As noted by a commenter, the implications of having a fuel tank in a zone expected to crush in any severe impact is an element of risk worthy of examination.[24]

Findings: Pacific Northwest (Cascade Service) Risk Assessment

This assessment is affected by considerable uncertainty based upon the general concerns explained immediately above. In addition--

15. The risk assessment utilizes as comparison cases an Amtrak consist with a single locomotive, no baggage car between the locomotive consist and the passenger cars, and no express equipment on the rear. This is arguably appropriate, but the comparison in each case would be more favorable to conventional equipment if different assumptions were to be employed.[25] Indeed, adding a single baggage car behind the conventional

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[23]Particular risks may take on greater weight in different contexts, however. For instance, on the BNSF from Barstow to Los Angeles, significant grades markedly increase the possibility that freight equipment might run away, striking the rear of a passenger train. Given the mass of the striking equipment, the potential to involve several occupied passenger cars would be high. In such a setting, use of a de-powered F40 to shield occupied passenger equipment would appear to be a necessity.

[24]Large quantities of fuel are not required to support a fire capable of taking life, as illustrated by the highway-rail crossing accident and subsequent collision with standing rail equipment at Bourbonnais, Illinois, on March 15, 1999.

[25]In intercity service, Amtrak often operates conventional passenger equipment with two locomotives and one baggage car on the head end. It is not unusual to operate with two locomotives and two or three baggage cars on the head end. This applies to the Empire Builder and to the Coast Starlight. Many Amtrak consists also include express cars or intermodal units on the rear. However, exceptions include the Surfliners (San Diegans), San Joaquins, Capitols, and Chicago area semi-short hauls. Further, the majority of Amtrak's daily trains, which operate on the Empire Corridor and Northeast Corridor, generally have a single locomotive (and may or may not employ a baggage car in the first trailing position, but do operate under automatic train control and over few or no highway-rail crossings). Thus, it is open to argument whether additional locomotives or unoccupied cars should be included in any "base case" against which a premium passenger train (configured to achieve the shortest feasible trip time) is compared. No such case was examined in Amtrak's risk assessments for the Talgo service.

locomotive hauling the train would, apparently, significantly alter the computations.

16. The corridor has a large number of highway-rail crossings for which the risk analysis appears to leave some questions open. Grade crossings on the route include significant numbers in the highest speed band (61-79 mph). A considerable number of these, particularly the private crossings, do not have active warning systems. The risk assessment does not consider whether the traffic mix for crossings on the corridor includes a larger-than-average proportion of heavy motor vehicles. The results are therefore somewhat sensitive to the assumption that the Talgo equipment will perform as well as the conventional consists in highway-rail crossing collisions.[26]

While these findings are not intended to suggest the need for alarm, the issues should be further developed as preparations are made to increase train speeds on this route. WDOT has invested considerable effort and has applied notable expertise in studying the mitigation of crossing risk on this corridor. Significant investments have been made, and more are planned. FRA will work with WDOT to encourage continued effort and creativity in this regard. It is also important that investments already targeted be made, and the conditions on this approval address that issue.

Commenters in this proceeding have suggested that FRA explore major initiatives to mitigate risk such as implementation of train control systems and closure of highway-rail crossings. FRA, Amtrak, and the freight railroads are pursuing the benefits of Positive Train Control (PTC).[27] However, PTC will be implemented on a larger scale than the corridors here under review, with benefits that will accrue to all rail movements. The Oregon and Washington State DOTs have pursued closure of crossings and will need to continue those efforts to focus safety improvements and to offset growth of highway traffic. BNSF and UP have participated in this effort. However, in this proceeding FRA cannot realistically require Amtrak to take actions that require approval of third parties and transportation implications that have not been examined in this docket. Accordingly FRA has focused on actions that are within the control of Amtrak, Talgo, and the host railroads.

Findings: Southern California and Los Angeles-Las Vegas Corridors

Information available to FRA is not yet adequate to support a fully detailed decision on these two corridors. The conclusion section which follows identifies concerns which will need to be addressed before a decision can be rendered.

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[26]The degree of sensitivity is not known. In discussion on the subject, ADL explained that highway-rail crossing collisions that result in secondary collisions with rail equipment or other obstructions are handled under those categories. However, in the case of impact with a very heavy motor vehicle, reaction of the train to the impact may influence whether secondary collisions ensue.

[27]*See* ***Implementation of Positive Train Control Systems*** (Report of the Railroad Safety Advisory Committee; September 8, 1999).

Conclusions and Agency Action

FRA concludes that sufficient information has been submitted to determine that the five Talgo trainsets can be operated consistent with railroad safety in the Pacific Northwest Corridor at maximum speeds not exceeding 79 mph. The trainsets and their predecessors have operated without incident on this corridor since 1994, and Amtrak has provided information tending to support the crashworthiness of the trainsets under the conditions specified. However, given the uncertainty related to the crash analysis, risk assessment, and other issues discussed above, FRA determines that the conditions attached to this approval are necessary to secure a reasonable level of confidence that safety will not be compromised.

FRA further concludes that continued use of these trainsets on the Pacific Northwest Corridor is in the public interest, given the success of the Talgo service in building ridership. Intercity passenger service on a corridor of this kind helps to relieve congestion affecting other modes of transportation (private motor vehicle travel and air travel, in this example). Efficient passenger service contributes to reduced fossil fuel use and reduced harmful emissions. Diversion of traffic from the highway mode will also reduce net casualties in surface transportation.[28]

This action does not address the issue of operation of Talgo trainsets at speeds in excess of 79 mph on the Pacific Northwest Corridor. The corridor presently is not equipped with Automatic Train Stop (ATS), Automatic Train Control, or Automatic Cab Signals that would permit higher speed operations (49 CFR §236.0).[29] Amtrak has not submitted risk assessment justification for higher speed operations on this corridor, despite the fact that WDOT and the Oregon DOT have obtained designation of this route as a high speed corridor pursuant to section 1103(c) of the Transportation Equity Act for the 21st Century and have detailed plans for increasing train speeds on portions of the route to 110 mph. FRA is persuaded that there are substantial uncertainties remaining with respect to the performance of Talgo trainsets that must be

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[28]This argument is most relevant to the public interest criterion, but less so to the "consistent with safety" criterion. While it is true that rail travel is much safer than private motor vehicle travel, Amtrak provides service as a common carrier that is more closely analogous to that provided by intercity buses or scheduled air carriers. In order to ensure that the safety of common carrier transportation continues to improve, it is appropriate to set safety objectives that are challenging when measured against appropriate benchmarks.

[29]On August 8, 2000, BNSF petitioned FRA for relief from 49 CFR §236.566, which requires all trains to be equipped with on-board equipment responsive to ATS in ATS territory, for three line segments including the BNSF line from Blaine, Washington to Portland, Oregon. BNSF asks that freight trains be permitted to be unequipped and that Amtrak trains be allowed to operate at speeds in excess of 79 miles per hour. The combination of these two proceedings asks that a European-specification trainset be permitted to operate at higher speeds under the protection of the least competent form of on-board train control with all other movements in the corridor unequipped. FRA will insist upon obtaining the best possible information before acting favorably on any such request.

[30]One commenter suggested that any approval be limited to a period of five years. FRA agrees with the point that continuing oversight of this service is desirable. However, it is in the public interest to avoid any

resolved before that stage of decision-making is reached. FRA will retain jurisdiction of this petition to address these issues as they unfold.[30]

Likewise, FRA is not prepared at this date to address service over the two corridors emanating from Los Angeles, California. The Southern California corridor includes significant segments where train speeds currently reach 90 mph with only passenger trains equipped with ATS, as well as segments where competing rail traffic is heavy. The corridor between Los Angeles and Las Vegas, Nevada, traverses some of the most challenging mountain grade territory in the United States. Both of these corridors have significant potential for the occurrence of a high-energy accident, with increased likelihood of a moderate energy event,[31] and FRA requires additional information before moving forward on these elements of the request.

One of FRA's principal data needs is better information regarding the likely performance of the articulated Talgo trainset under adverse conditions. Recognizing that sophisticated collision dynamics modeling is an art still under development, FRA last year commissioned a study effort to develop an articulated trainset crash model through the Volpe Center. As this decision was being prepared, the tentative findings of that effort were under review and editing. The relevance of that study to this docket is said to be expressly reliant on ***assumptions*** that the Volpe Center contractor was required to make with respect to the Talgo trainsets' design and materials that might affect the behavior of the trainsets (with respect to crush, override and lateral displacement). Although Talgo representatives were invited to provide appropriate detail to support development of the model and application to the trainsets, they did not do so.

FRA will not rely on results of that model development effort until FRA is confident that the present model, or a subsequent iteration more faithful to Talgo's actual design, fairly represents the relevant aspects of the construction of the trainsets as confirmed by data provided by the manufacturer in a verified statement. Accordingly, before FRA takes further action on the petition, Amtrak and Talgo must provide design and other data sufficient to enable FRA to evaluate the crashworthiness and dynamics behavior of the Talgo Pendular articulated trains through a generic 3-dimensional model. These data must include information sufficient to enable FRA to conduct an evaluation of the structural welding used by Talgo and the aluminum strength properties for tear and shear.

As noted above, during discussions with Amtrak prior to submission of the petition, FRA's mechanical engineering staff requested that Amtrak consider enhancements to certain

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implication that this successful passenger service could be subject to disruption as of a fixed date. FRA will review the status of the service as required by changes in the service environment and experience under this approval.

[31]In this context, risk is strongly affected by *average* train speeds on the line; maximum speeds are of interest not only because of the potential for a truly catastrophic event but also because they tend to drive up average closing speeds in higher probability scenarios. Special circumstances such as heavy grades also introduce risk elements that may not be successfully captured by risk assessment techniques that rely upon national averages.

characteristics of the Talgo equipment to compensate for the more severe U.S. service environment. FRA believes that satisfaction of these requirements will contribute significantly to retention of the bogie and suspension mechanism and thus to the integrity of the trainset. Availability of spare equipment should prevent any disruption of service associated with the retrofit. Additional conditions attached to this approval address further risk mitigation in an orderly and non-disruptive manner.

The petition is therefore approved with respect to operations on the Pacific Northwest Corridor, subject to the conditions set forth below:

1. This approval is granted only for operation of the 65 Talgo rail cars (articulated units) enumerated in Amtrak's petition as amended.

2. This approval only applies on the current route between Eugene, Oregon, and the United States/Canadian border near Blaine, Washington, via trackage of the UP and BNSF.

3. Amtrak shall modify the Talgo rail cars according to the following schedule and requirements. Within 60 days following the date of this decision and at least 14 days prior to beginning retrofit of the equipment, Amtrak and Talgo shall provide to FRA for its review and approval final mechanical drawings and specifications for the modifications. These drawing and specifications must include as a minimum all dimensions and material specifications, including the strength of structures to which reinforcements are attached. Not longer than 270 days after the date of this decision, all equipment then or thereafter in grandfathered service shall have been modified according to the agreed-upon requirements. The following improvements must be made:

    a. The rail cars must be modified to increase the strength of the weight bearing bars (two per car) and their related supports to the car structure, to withstand, at a minimum, a 100,000 pound vertical load, applied either up or down.

    b. The rail cars must be modified by applying safety cables between the cars and bogies to resist a minimum total longitudinal force of 77,162 pounds to resist separation of the carbodies and bogies.

    c. The rail cars must be modified by applying safety cables around the top of each suspension column, affixed to the upper structure of the cars to resist the application of a nominal 250,000 pound force, applied at the center of gravity of the bogie.

    If all of the conditions regarding modification to the five trainsets are not fulfilled within the specified time period of nine-months, Amtrak shall cease operation of any equipment that has not been so modified until the modification is complete.

4. Amtrak must operate the rail cars in dedicated trainsets as proposed in Amtrak's petition.

When operating in revenue or deadhead service, the baggage and end service cars shall be placed at the ends of the remaining cars in the trainset and must not be occupied by passengers or crew members.

5. The trainsets may be operated in either locomotive-hauled or push-pull service. In locomotive-hauled service, the trainset may be followed by a locomotive-type cab control car (e.g., de-powered F40) at Amtrak's election. In push-pull service, revenue and deadhead trains must be operated with a locomotive or locomotive-type cab control car on both ends. In either locomotive-hauled or push-pull service, additional equipment in the train consist (e.g., passenger cars, freight cars, materials handling cars, and bi-modal equipment) is prohibited. As used in this paragraph, "locomotive" refers to a passenger locomotive of at least 200,000 pounds in weight. The following conditions apply if it is necessary to substitute motive power due to the failure en route of the F59 assigned to the consist: (i) a passenger locomotive will be substituted if available; (ii) if a passenger locomotive is not available, the freight unit shall be placed at the front of the consist unless it is not possible to do so within a reasonable time, given the need to orient the short hood forward, and (iii) if it is not possible to place the substituted freight unit at the front of the consist, the consist shall be controlled from the front of the train and the speed of the train shall be limited to 40 mph until the pushing locomotive is removed from the rear of the consist.

6. Within 60 days of the date of this decision, Amtrak shall provide further engineering and other analysis sufficient to determine the relative sensitivity, in terms of net risk, of operating the Talgo consist in push-pull configuration, rather than with the locomotive leading in every case (without any control cab on the rear). This analysis shall address the respective risk conditions on each of the three corridors, including the Pacific Northwest Corridor. Amtrak may, at its election, address public interest considerations related to the push-pull configuration (but, if this is done, the impact of additional weight on trip time and ridership shall be included).

7. The maximum speed of the trainsets may not exceed 79 mph, with a maximum of six (6) inches of cant deficiency, subject to further requirements as provided under Waiver RST-97-4.

8. Within 90 days of the date of this decision, Amtrak must provide a precise specification of the track, signal system, and grade crossing safety projects assumed for completion by 2003 as referenced in the risk assessment (Appendix D to the petition, page 6). Amtrak shall report to FRA by the 5th of January of each year the progress of the state agencies, host railroads and Amtrak toward completion of these improvements until these projects are complete. FRA will monitor Amtrak's progress towards achieving the noted improvements and may require additional conditions if needed.

9. Amtrak must initiate a formal program, in conjunction with the freight railroad track

owners, state transportation agencies, and other interested parties, to assess the safety benefits of installation and use of wide load/shifted load detectors at the primary locations where intermodal and/or forest products enter the territory where Talgo trainsets operate and at appropriate locations within the territory. Recommended actions shall be reported to FRA within 180 days following the date of this decision, accompanied by a statement of the reasons for concluding that those actions are sufficient. FRA will, by amendment to this decision, specify what actions must be taken and when those actions must be completed. Attached to this decision is a brief description of the hazard detection issue.

10. Within 180 days of the date of this decision, Amtrak must prepare an engineering analysis reviewing the design and securement of the steel structure affixed to the end service car and the baggage car that contains the draft gear and collision posts. The analysis shall confirm the ability of the draft arrangement to transfer normal in-train forces into the carbody of the end unit. It shall include a fatigue analysis establishing the ability of the draft arrangement and its attachments to withstand expected service loads without failure. This analysis shall be coordinated with the analysis required by Condition No. 6. In addition, the analysis shall review the ability of the structure to transfer collision loads under the conditions assumed in the Crashworthiness Analysis submitted with the petition.

11. Within 90 days of this decision, Amtrak must submit for FRA approval a proposed plan of action to reduce the risk of fuel loss from the tank suspended from the end service car and a timetable for completion of the required actions. Amtrak should consider options that include substitution of a tank meeting the criteria of §238.223(a) or a tank utilizing increased puncture resistance and a tear-resistant internal bladder.

Except as provided above, the petition remains pending and is neither approved nor disapproved.

Issued at Washington, D.C., on September 8, 2000.

/ original signed by /

Grady C. Cothen, Jr.
Deputy Associate Administrator
for Safety Standards and Program Development
(Chairman, Railroad Safety Board)

Review of Pacific Northwest Corridor Hazard Detection Systems

Current Status of Detectors

There are currently 38 detectors located on the route used by the Talgo equipment in the States of Washington and Oregon. None of the detectors include detection of shifted loads. A "dragger" is a dragging equipment detector, and "hot box" indicates a overheated journal (bearing) detector. They are located and equipped as follows:

Location	Type	Passenger Speed
Union Pacific (Portland to Eugene)		
765.6	Dragger	45
757.5	Dragger/ hot box	40
750.1	Dragger/ hot box	45
737.8	Dragger	70+
725.2	Dragger/ hot box	70
710.0	Dragger/ hot box	70+
701.7	Dragger	70+
697.8	Dragger/ hot box	70
681.1	Dragger/ hot box	70+
675.2	Dragger	70+
670.2	Dragger/ hot box	70+
662.4	Dragger	70
657.1	Dragger/ hot box	79
646.1	Dragger	40

Burlington Northern (PA Junction to Canadian border)

Location	Type	Talgo Speed
46.2	Dragger	79
55.2	Dragger	79
67.4	Dragger	79
74.6	Dragger	45
46.2	Dragger	79
55.2	Dragger	79
58.9	Both*	79
67.4	Dragger	79
74.6	Dragger	79
81.9	Both	79

110.5	Both	79

Burlington Northern (Seattle to PA Junction)

6.0	Dragger Main 2	30
9.7	Dragger	50
17.1	Both	60
27.2	Both	45

Burlington Northern (Seattle to Vancouver)

4.6X	Both	79
10.1	Both	63
18.5	Dragger	75
18.5	Dragger	75
26.4X	Both	79
30.0	Both	65
57.9	Both	79
87.4	Both	79
113.5	Both	79

*"Both" indicates that the location is equipped for detection of both overheated journals and dragging equipment.
Note: In some cases detectors are set up for only one direction of travel or for less than all main tracks.

This information, which was derived from railroad timetables, indicates significant attention to the hazards of dragging equipment and overheated bearings, with benefits accruing to all traffic on the corridor. Talgo trainsets are also equipped with on-board hot bearing detection which addresses the partial inability of wayside detectors to detect hot bearings on the trainsets. However, no specific attention has apparently been given to detection systems to identify shifted loads on this route.

Shifted Load Detection

Accident History. During the period, 1995 to May, 2000 there were a total of 243 reported train accidents in the United States that were attributed to lading causes. Two were reported as happening in the states of Oregon and Washington. Sixty-six of those were reportedly due to shifted loads, two in the mentioned states. However, any of the 243 accidents could have been related to lading that projected into the path of an opposing train. Only a case by case review of all accidents could result in a positive statement related to the specific cause of the accident.

Investigative Findings. In concert with the major railroads and labor organizations, FRA has engaged in active monitoring of trailer and container securement on railroad intermodal cars across the Nation. During inspections at major facilities on the Pacific Northwest corridor in the State of Washington in July of 2000, one FRA inspector noted numerous "out of proper position" container width guides and unlocked inter-box connectors. A double stack container load was found shifted in the well (resting on top of pedestal) due to improperly positioned width guides. Worn out container latches were found to be a continued a problem. These finding illustrate FRA's ongoing concern regarding exposure of crew members and passengers to shifted loads in trains on adjacent tracks.

Nature of Rail Traffic. As noted in the docket, the Amtrak Cascade Talgos operate in territory with significant freight traffic. The traffic mix includes both intermodal containers and forest products. Among the forest products are processed wood moving in bulkhead flatcars and tree-length logs moving on standard flat cars with side stakes. If a shifted load were to strike a Talgo train it could result in intrusion into the occupied portions of the cars and derailment of the trailing portion of the consist (with further potential for a secondary collision).

Action. In conjunction with BNSF and UP, Amtrak should arrange for the installation of wide load/ shifted load detectors at the primary locations where intermodal and/or forest products enter the corridor or at subsequent locations proximate to those points of entry.

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